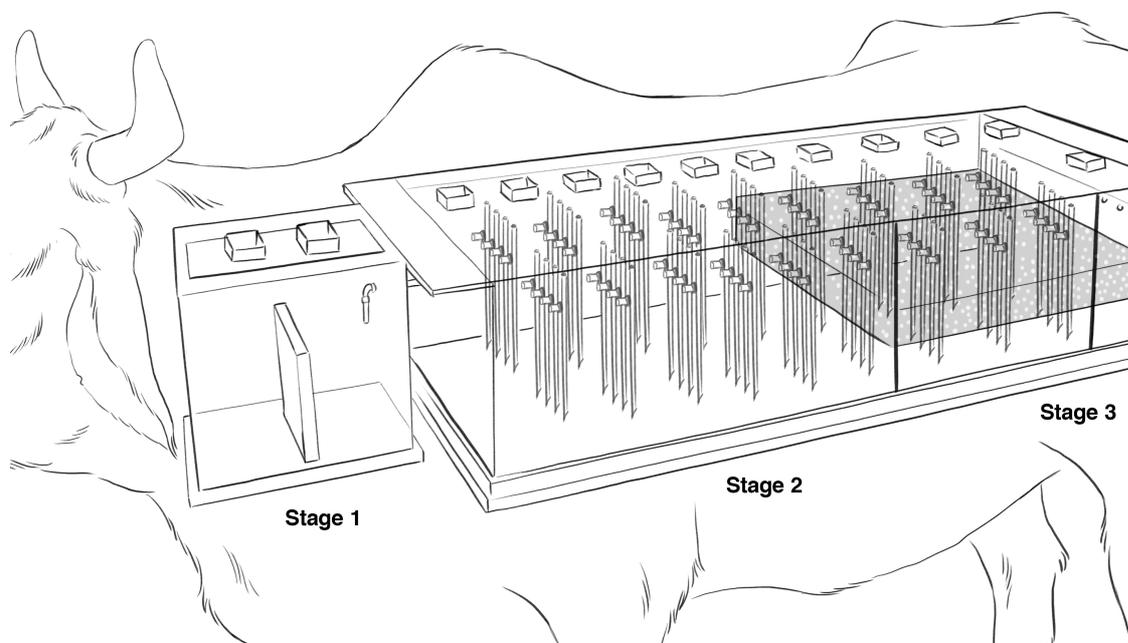


Sustainability Frameworks Compliance Whitepaper

(Biomimicry Institute and UN Sustainability Development Goals)



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TABLE OF CONTENTS

1. Introduction

- A. Nature’s unifying pattern’s Page 3
- B. United Nations SDG FrameworkPage 3

2. Nature's unifying pattern's framework

- A. Nature’s unifying pattern # 1 Page 4
- B. Nature’s unifying pattern # 2 Page 5
- C. Nature’s unifying pattern # 3 Page 6
- D. Nature’s unifying pattern # 4 Page 6
- E. Nature’s unifying pattern # 5 Page 7
- F. Nature’s unifying pattern # 6 Page 8
- G. Nature’s unifying pattern # 7 Page 8
- H. Nature’s unifying pattern # 8 Page 9
- I. Nature’s unifying pattern # 9 Page 10
- J. Nature’s unifying pattern # 10 Page 10

3. Sustainable Development Goals

- A. ECOSTP SDG Compliance Page 12
- B. SDG 3: Good Health and Well-Being..... Page 12
- C. SDG 6: Clean Water and Sanitation..... Page 13
- D. SDG 8 : Decent Work and Economic Growth..... Page 13
- E. SDG 9: Industry, Innovation, and Infrastructure..... Page 14
- F. SDG 11: Sustainable Cities and Communities..... Page 14
- G. SDG 12: Responsible Consumption and Production..... Page 15

4. Summary

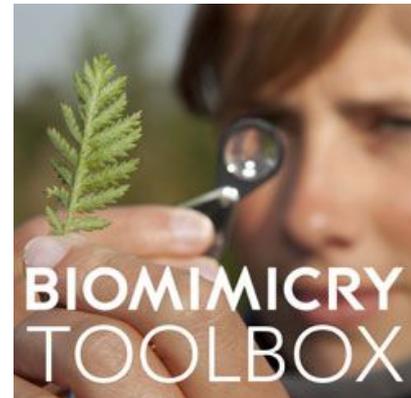
- A. Adherence to frameworks Page 16

Introduction

- As nowadays every product is green washed¹ and claim they are sustainable, in this white paper we are explaining the sustainability benefits of ECOSTP sewage treatment solution with reference to two globally accepted frame works.

1. **Nature's unifying patterns Framework from Biomimicry Institute.**
(Note: We are mentored² by Biomimicry Institute, Montana.)
2. **United Nations SDG Framework.**
(Note: ECOSTP Technology is selected as a Best Practice case study for United Nations SDG Sustainability Asia Pac report³.)

"Nature's unifying patterns is our attempt to identify the 10 most essential lessons from the natural world that should be considered as part of a design process. We call them "nature's unifying patterns" because examples of the patterns can be found broadly across the majority of life on Earth." - Biomimicry Institute



"The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice. The 17 Goals are all interconnected, and in order to leave no one behind, it is important that we achieve them all by 2030." - United Nations



¹ <https://en.wikipedia.org/wiki/Greenwashing>

² <https://innovation.biomimicry.org/team/ecostp/>

³ <https://www.unescap.org/resources/enabling-policies-financing-water-related-sustainable-development-goals>

Nature's unifying patterns framework



Pic courtesy - Biomimicry Institute

Biomimicry Institute created the 10 point framework to explain on how nature functions. The definition as per Biomimicry Institute is as mentioned below

"From a systems perspective, life allows other life to flourish. If we aim to build a world that is sustainable (i.e. compatible with life on Earth over the long haul), we need to consider nature's lessons in a systems context. The 10 patterns are worth paying attention to because they can have profound implications for human design. Nature's unifying patterns is the attempt to identify the 10 most essential lessons from the natural world. They are called "nature's unifying patterns" because examples of the patterns can be found broadly across the majority of life on Earth."

The Biomimicry Toolbox⁴ provides detailed explanation with real world examples.

Now let us look at each of the patterns and see how ECOSTP sewage treatment system fits in each of these patterns

1. Nature's unifying pattern #1 : Nature uses only the energy it needs and relies on freely available energy.

- The definition⁵ as per them is as mentioned below

⁴ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/>

⁵ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/energy/>

- *"Energy is an expensive resource for all organisms; the risk of using excess energy is death or the failure to reproduce. Therefore, they use it sparingly, tailoring their needs to the limited amount of energy available. While no energy is "free," because all energy requires expenditure of energy to obtain it, nature's sources for energy are freely available because they are renewable, are found locally, and don't need to be mined. Freely available energy includes sources such as electrons from sunlight used by plants for photosynthesis, rising air currents, wind, dissolved minerals from deep sea vents, decomposing organic materials, and nutrients from plants and animals that organisms feed upon."*
- Now let us audit and verify how ECOSTP measures to this unifying pattern

Gravity based System : ECOSTP system does not need power to run. It uses gravitational force -the 'freely available' energy to function. Water flows through stage 1 and 2 chambers vertically and horizontally through pipes. Water then flows horizontally through stage 3 plant gravel filters and vertically via stage 4 sand filters. Gravity is a natural phenomenon by which all things with mass or energy—including planets, stars, galaxies, and even light, are brought toward (or gravitate toward) one another. We cleverly leveraged this universal life force to clean waste water.

2. Nature's unifying pattern #2 : Nature recycles all materials.

- The definition⁶ as per Biomimicry Institute is as mentioned below
- *"In nature, one organism's waste or decomposing body becomes a source of food and materials for other organisms. While we talk about "recycling," "upcycling" is a more accurate description of what happens in nature. There are usually many organisms, or more accurately, ecosystems of organisms, that break down complex organic materials and molecules into smaller molecules that can then be taken up and reassembled into completely new materials. Just as there is a hydrological cycle, there are many other cycles involving organic matter (carbon cycle, nitrogen cycle, etc.) that function as local, regional, and whole-earth systems."*
- Now let us audit and verify how ECOSTP measures to this unifying pattern

Recycling :In the ECOSTP system we recycle all wastewater that comes in. In fact our mission is 'Reclaim every drop of wastewater, naturally.' The incoming fecal matter is converted into recycled water and gas which we will be using for lighting. The sludge digestate is a fertilizer. Absolutely nothing is wasted. In addition to gardening our clients use the treated water for flushing and car wash. One client has a potable quality 'Toilet to Tap' implementation also.

3. Nature's unifying pattern 3 : Nature is resilient to disturbances.

- The definition⁷ as per Biomimicry Institute is as mentioned below
- *"Being resilient is about having the ability to recover after disturbances or significant, unpredictable changes in the local environment, such as those caused by a fire, flood, blizzard, or injury. Diversity, redundancy, decentralization, self-renewal, and self-repair can all enable resiliency in nature and the ability to maintain function despite a disturbance."*
- Now let us audit and verify how ECOSTP measures to this unifying pattern

Resilience : ECOSTP is very resilient to external disturbances - it manages STP operation without human intervention. We chose anaerobic bacteria (instead of aerobic bacteria) for a specific reason. When incoming food is less, the bacteria production is less, and when food is more, they multiply creating a dynamic system (a.k.a. shock load prevention). Translating this to real life, for example, in a housing complex, if there is a wedding ceremony and sewage load is high, the system still treats. During recent urban flooding and the COVID-19 crisis, clients who had ECOSTP installed was functioning smoothly as we are not dependant on power or operators. Many of the conventional STP's which depended on STP operators failed during the lock down crisis.

4. Nature's unifying pattern 4 : Nature tends to optimize rather than maximize.

- The definition⁸ as per Biomimicry Institute is as mentioned below
- *"Because energy and materials are so precious, nature seeks a balance between resources taken in and resources expended. Energy spent on excess growth, for example, could result in insufficient energy reserves or characteristics that harm an organism's ability to survive and reproduce, which means that it won't be able to pass on its genes. There are checks and balances in both organisms and ecosystems, some of which occur over generations. Growth for growth's sake will result in harmful side effects."*

⁷ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/resilient/>

⁸ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/optimize/>

- Now let us audit and verify how ECOSTP measures to this unifying pattern

Optimisation vs Maximisation : We use the different treatment stages appropriately to achieve our end goal of complying to local pollution PCB standards without increasing the size of the plant so that it is cost effective and is “fit for purpose.” ECOSTP requires more space than conventional systems, so we have to design a highly optimized system as our chosen market is housing complex/apartments with little to no extra space. In our designs, we situate the treatment unit below the roads or playground so that existent space is utilised well. Our living system also serves multiple functions with one design element, i.e. sewage treatment AND disinfection. Our system does both - clearly optimising the resources as nature intended.

5. Nature’s unifying pattern 5 : Nature provides mutual benefits.

- The definition⁹ as per Biomimicry Institute is as mentioned below
- *“Among the variety of ways that organisms interact with each other, there are many examples of interactions that provide mutual benefits. The benefits may be simple byproducts of specific behaviors—for example, when one organism’s waste is another organism’s resource—or they may arise out of close relationships that evolved over time. Mutualistic symbioses are one example of a close relationship between different kinds of organisms, where all the partners benefit from the relationship.”*
- Now let us audit and verify how ECOSTP measures to this unifying pattern

Mutual Benefits : As ECOSTP is a 'living system', mutual benefits are key to sustaining the ecosystem. The symbiotic bacteria and fungi work on the four anaerobic digestion stages as “one’s output is another’s input.” We created a petri dish of sorts to allow all these to stages to function as a system to clean wastewater. To explain further - The waste from 1st stage hydrolysis is subsequently metabolized in the acidogenesis phase by acidogenic bacteria which feeds to acetogenic bacteria and then by Methanobacterium bacteria. After this stage the water flows through the plant gravel filter wetland which absorbs the nutrients in the water. In other words it is an amazing symbiotic system working on mutual benefits - exactly how it happens in nature.

⁹ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/cooperation/>

6 : Nature's unifying pattern 6 : Nature runs on information.

- The definition¹⁰ as per Biomimicry Institute is as mentioned below
- *To be attuned to their environment, organisms and ecosystems need to receive information from the environment and be able to act appropriately in response to that information. This includes sending and receiving signals to and from other organisms or even within the body of an organism. This system of send, receive, and respond has been finely tuned through millions of years of evolution. Using feedback loops is one way to monitor those conditions. Both negative feedback loops (those that slow down a process), and positive feedback loops (those that speed up a process) are important in natural systems.*
- Now let us audit and verify how ECOSTP measures to this unifying pattern

Information : As this is a living system, the system of “send, receive, and respond,” which has been finely tuned through millions of years of evolution, is already in action. For example, if incoming food increases, bacteria multiply to take care of the load. If food is not there the bacteria count decreases and goes to hibernation. It is a self-healing system and once deployed it simply runs with little maintenance. In a conventional STP system aerobic bacteria is added hourly as part of MLSS process and is operator dependant. In ECOSTP it works automatically as it is based on natural principles. The entire system runs on 'information' automatically without any manual intervention.

7 : Nature's unifying pattern 7 : Nature uses chemistry and materials that are safe for living beings.

- The definition¹¹ as per Biomimicry Institute is as mentioned below
- *"Organisms do chemistry within and near their own cells. This makes it imperative that organisms use chemicals, chemical processes, and chemistry-derived materials that are supportive to life's processes. Life's chemistry is water-based and uses a subset of chemical elements configured into precise 3D structures."*

¹⁰ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/information/>

¹¹ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/chemistry/>

- Now let us audit and verify how ECOSTP measures to this unifying pattern

Simplicity : ECOSTP solution does NOT use any chemicals. Of the 118 chemical elements in the periodic table of elements, nature uses primarily only four of them: carbon, hydrogen, nitrogen, and oxygen. We follow the same model. The system also incorporates a natural slow sand filter for disinfection. It is completely safe with no harmful by products. Similar to how nature functions.

8 : Nature's unifying pattern 8 : Nature builds using abundant resources, incorporating rare resources only sparingly.

- The definition¹² as per Biomimicry Institute is as mentioned below
- *"Nature's materials are abundant and locally sourced. This is true whether an organism is building something external to itself, like a termite mound or a nest, or assembling materials that are part of the body, e.g., a wing, shell, leaf, or horn. The most common and abundant basic building blocks—chemical compounds—are those that are formed from the most common and readily found elements on earth: carbon, nitrogen, hydrogen, and oxygen. A few rarer minerals are also used, but these are found locally and are readily available, not mined, processed, or shipped thousands of miles."*
- Now let us audit and verify how ECOSTP measures to this unifying pattern

Abundant resources usage : We use only nature's materials which are abundant and locally sourced. For the bacteria substrate we use easily available local cow dung. Wherever possible we use earth (compressed mud blocks) to construct . This is similar to how Barn Swallows construct their nests with local mud. The best evidence is to listen to one of our customers speaking passionately about STPs made of local mud in a video here (<https://www.youtube.com/watch?v=5uSZbmSzigA>) . We don't use any rare resources or chemicals.

¹² <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/resources/>

9 : Nature's unifying pattern 9 : Nature is locally attuned and responsive.

- The definition¹³ as per Biomimicry Institute is as mentioned below
- *"Chances of survival increase when individuals are good at recognizing local conditions and opportunities and locating and managing available resources. Survival also depends on responding appropriately to information garnered from the local environment. Organisms and ecosystems that are present in a location evolved in direct response to local environmental conditions. Being able to respond to these changes, again using them as opportunities, allows organisms and ecosystems to flourish."*
- Now let us audit and verify how ECOSTP measures to this unifying pattern

Locally Attuned : We don't make STPs centrally and ship. Instead, we sell the core technology, a DIY Kit which clients buy and make locally at site using locally available materials and workforce. We use locally abundant materials, mimicking nature by not relying on scarcity, and using resources from the immediate surroundings. ECOSTP building materials are attuned and responsive to our customers in each region. For example, in some parts of Karnataka, it is easy to make rammed earth bricks, so we propose this to customers. Using these local materials allows a significant reduction in the carbon footprint.

10: Nature's unifying pattern 10 : Nature uses shape to determine functionality.

- The definition¹⁴ as per Biomimicry Institute is as mentioned below
- *"Nature uses shape or form, rather than added material and energy, to meet functional requirements. This allows the organism to accomplish what it needs to do using a minimum of resources. Forms can be found in the shape of a beetle's back and in the multi-layer structure of a tropical rainforest. If we notice a form in nature, with very rare exceptions, there's almost always a functional reason behind that form."*

¹³ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/local/>

¹⁴ <https://toolbox.biomimicry.org/core-concepts/natures-unifying-patterns/shape/>

- Now let us audit and verify how ECOSTP measures to this unifying pattern

Shape to determine function : Natural systems like ECOSTP need more space and there is hardly any space in cities like Bangalore. Accordingly, we have developed a clever wax design model to customize the three stages to the client environment and ECOSTP wraps around the contours. We mastered the art of manufacturing by 'building to shape' which is highly appreciated with many client validations. Example pls watch one client speaking how we use shape to determine function (<https://www.youtube.com/watch?v=lmKUWz1Zzmc&t=11s>) Usually stage 1,2 and 3 is constructed below the basement or road and stage 4 is integrated as garden or fencing. We do exactly what nature does. ECOSTP melts into available space.

We have now completed comparing ECOSTP with the 10 nature's unifying patterns Framework from Biomimicry Institute. Now let us look at the SDG¹⁵ framework and compare how ECOSTP system matches.

Sustainable Development Goals (SDGs)



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For queries on usage, contact: dpicampaign@un.org

¹⁵ <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

The Sustainable Development Goals¹⁶ (SDGs) are a collection of 17 global goals designed to be a "blueprint to achieve a better and more sustainable future for all". The SDGs, set in 2015 by the United Nations General Assembly and intended to be achieved by the year 2030, are part of UN Resolution.

The Sustainable Development Goals

SDG 1 : No Poverty
SDG 2 : Zero Hunger
SDG 3 : Good Health and Well-being
SDG 4 : Quality Education
SDG 5 : Gender Equality
SDG 6 : Clean Water and Sanitation
SDG 7 : Affordable and Clean Energy
SDG 8 : Decent Work and Economic Growth
SDG 9 : Industry, Innovation, and Infrastructure

SDG 11 : Sustainable Cities and Communities
SDG 12 : Responsible Consumption and Production
SDG 13 : Climate Action
SDG 14 : Life Below Water
SDG 15 : Life On Land
SDG 16 : Peace, Justice, and Strong Institutions
SDG 17 : Partnerships for the Goals

ECOSTP SDG Compliance

ECOSTP sewage treatment system addresses six Sustainable Development Goals

1. Good Health and Well-Being (SDG 3),
2. Clean Water and Sanitation (SDG 6),
3. Decent Work and Economic Growth (SDG 8),
4. Industry, Innovation and Infrastructure (SDG 9),
5. Sustainable Cities and Communities (SDG 11),
6. Responsible Consumption and Production (SDG 12)

The detailed explanation and clause wise fitment of ECOSTP is provided below.

1. SDG 3: Good Health and Well-Being

- SDG INDICATOR¹⁷ 3.9.2 Mortality rate from unsafe water, sanitation, hygiene (WASH)
- *Definition: Indicator 3.9.2 is the "mortality rate attributed to unsafe water, sanitation, and lack of hygiene". Mortality rate from water,*

¹⁶ https://en.wikipedia.org/wiki/Sustainable_Development_Goals

¹⁷ <https://sdg-tracker.org/economic-growth>

sanitation and hygiene (WASH) factors is measured as the number of attributed deaths per 100,000 people.

- Now let us audit and verify how ECOSTP measures to this SDG

SDG 3 : ECOSTP scores high here as we are the natural sanitation solution. We convert bad water to good water without using any power or chemicals.

2. SDG 6: Clean Water and Sanitation

- SDG INDICATOR¹⁸ 6.3.1 Safe sanitation and hygiene Definition:
- *Definition: Indicator 6.3.1 is the proportion of wastewater safely treated. Halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally by 2030.*
- Now let us audit and verify how ECOSTP measures to this SDG

SDG 6 : ECOSTP scores high here as we are the natural sanitation solution. We convert bad water to good water without using any power or chemicals and is safe for reuse.

3. SDG 8: Decent Work and Economic Growth

- SDG INDICATOR¹⁹ 8.8.1 Occupational injuries
- *Definition: Indicator 8.8.1 is the frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status. Data for this indicator reports the frequency rates of non-fatal and fatal occupational injuries by country. This is measured as the number of injuries per 100,000 employees. Goal is to Protect labour rights and promote safe and secure working environments for all workers by 2030.*
- Now let us audit and verify how ECOSTP measures to this SDG

SDG 6 : In ECOSTP system there are no operators so this clause is adequately addressed. in traditional STP systems, operators live a difficult life as they are exposed to harmful STP fumes daily. STP operator deaths also is very common. They belong to unorganised sector with little labour rights. In ECOSTP there are no operators.

¹⁸ <https://sdg-tracker.org/water-and-sanitation>

¹⁹ <https://sdg-tracker.org/economic-growth>

4. SDG 9: Industry, Innovation, and Infrastructure

- SSDG INDICATOR²⁰ 9.4.1 CO2 emissions per unit value added
- *Definition: Indicator 9.4.1 is CO2 emissions per unit of value added. This indicator is a measure of carbon intensity; it reports the quantity of carbon dioxide emissions generated per unit of economic value (kilograms of CO2 emitted per dollar of GDP). Goal is By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.*
- Now let us audit and verify how ECOSTP measures to this SDG

SDG 9 : ECOSTP does not need power to operate which means phenomenal CO2 savings. Note that in India and many developing countries power is predominantly fossil fuel based. We should consider the water and energy connection also. As you are aware water and energy are deeply connected. Producing energy uses and pollutes lots of water. Similarly, providing water requires large amounts of energy. ECOSTP works on gravity and does not need any power.

5. SDG 11: Sustainable Cities and Communities

- SDG INDICATOR²¹ 11.C.1 Sustainable and resilient buildings in least developed countries
- *Definition: Indicator 11.C.1 is the proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings utilizing local materials. Goal is to Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials by 2030.*

²⁰ <https://sdg-tracker.org/infrastructure-industrialization>

²¹ <https://sdg-tracker.org/cities>

- Now let us audit and verify how ECOSTP measures to this SDG

SDG 11 : ECOSTP solution is integrated as part of a sustainable building built using local materials. The natural system is self sustaining and designed to last for generations. Sustainable cities needs decentralised systems like ECOSTP.

6. SDG 12: Responsible Consumption and Production

- SDG Indicator²² 12.2.1 is material footprint, material footprint per capita, and material footprint per GDP.
- *Definition: Material Footprint (MF) is the quantity of material extraction that is required to meet the consumption of a country. The total material footprint is the sum of the material footprint for biomass, fossil fuels, metal ores and non-metal ores. Goal is to by 2030, achieve the sustainable management and efficient use of natural resources.*
- Now let us audit and verify how ECOSTP measures to this SDG

SDG 12 : ECOSTP use only Nature's materials which are abundant and locally sourced. For the bacteria substrate we use easily available local cow dung. Wherever possible we use earth (compressed mud blocks) to construct . No motors, filters or chemicals are used which reduces the material footprint.

²² <https://sdg-tracker.org/sustainable-consumption-production>

Summary

Adherence to Frameworks : As we have seen so far, ECOSTP is a sustainable natural sewage treatment system which we referenced through two frameworks so that we get a complete perspective. We completely adhere to the '10 unifying patterns of nature' framework of Biomimicry Institute and confirm to six (out of seventeen) sustainable development goals of the UN SDG framework.

Clearly there is no sewage treatment system other than us which matches these. ECOSTP company mission is to *'reclaim every drop of wastewater, naturally.'* Nowadays every product is green washed and claim they are sustainable - so it is important to explain this in detail via a referenceable audit with objective evidence.

End Note : As mentioned earlier we are mentored by Biomimicry Institute <https://innovation.biomimicry.org/team/ecostp/>

ECOSTP Technology was also discussed in 8th World Water Forum (Brasilia, 2018) and subsequently selected as a Best Practice case study for United Nations SDG Sustainability Asia Pac report. The document can be downloaded here <https://www.unescap.org/resources/enabling-policies-financing-water-related-sustainable-development-goals>

Nature's Unifying Patterns

- Use available energy
- Recycle materials
- Be resilient
- Optimize > maximize
- Mutual benefits
- Use information
- Use safe chemistry
- Use abundant resources
- Be locally attuned
- Use shape for function



***** END OF DOCUMENT *****